NEW LOCATIONS AND HOST PLANTS FOR LEICHHARDT'S GRASSHOPPER *PETASIDA EPHIPPIGERA* WHITE (ORTHOPTERA: PYRGOMORPHIDAE) IN THE NORTHERN TERRITORY

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Abstract

New locations for Leichhardt's grasshopper, *Petasida ephippigera* White, are recorded in the Northern Territory. Food plants (all Verbenaceae) were *Pityrodia lanuginosa* Munir, *P. puberula* Munir and *P. spenceri* Munir at Nitmiluk (Katherine Gorge) National Park (all new records) and *P. ternifolia* (F. Muell.) Munir at Bullo River Station and southeastern Arnhem Land. The grasshopper may be more secure in suitable habitat within its core distribution than previously believed, but must still be considered vulnerable in geographical outliers.

Introduction

Leichhardt's grasshopper, *Petasida ephippigera* White, is one of Australia's most strikingly coloured insects, being a vivid orange-red with navy blue and black markings (Fig. 1). Its image is frequently used in tourism promotions for the Northern Territory (NT) and it has appeared on two Australian postage stamps. Yet, in spite of its relatively high profile, details of the biology, ecology and even the geographical distribution of Leichhardt's grasshopper remain very poorly understood (Lowe 1995).

The well-camouflaged nymphs of *P. ephippigera* (Figs 2-3) are first seen on *Pityrodia* shrubs after the last storms of the summer monsoonal wet season and reach maturity early in the following wet season (Lowe 1995). Oviposition has yet to be observed, but other members of the family Pyrgomorphidae typically lay their eggs in batches in the soil (Rentz 1996). Adults of *P. ephippigera* die soon after the eggs are laid, their corpses frequently being found beneath the host plants late in the wet season.

Aboriginal people of western Arnhem Land have long regarded the grasshopper as a child of Namarrgon, the lightning man depicted in rock art throughout the region, as the arrival of the showy adults coincides with the violent thunderstorms that herald the onset of the monsoon. However, prior to 1970, *P. ephippigera* was only known to western science from five faded specimens in European collections (Calaby and Key 1973).

The first known specimen was collected during surveys of the Australian coast by the HMS *Beagle* expedition, probably in 1839 somewhere along the Victoria River, NT. The explorer Ludwig Leichhardt collected a second and reported seeing many others on the western edge of the Arnhem Land plateau in November 1845 (Leichhardt 1847), while a third was found during the

Figs 1-5. (1-3) *Petasida ephippigera*: (1) mating adults on *Pityrodia ternifolia*, Keep River National Park; (2) early nymph on *Pityrodia lanuginosa*, above Katherine River gorge, Nitmiluk National Park; (3) advanced nymph on *Pityrodia spenceri*, near Edith Falls, Nitmiluk National Park. (4-5) Typical habitat for *P. ephippigera*: (4) Bullo River Station - note the adult *P. ephippigera* (arrowed) on *P. ternifolia* in the foreground; (5) above Katherine River gorge.

Gregory expedition of 1855-6, also at an undefined location along the Victoria River. Two other specimens lacked any accompanying data. For more than 100 years this spectacular grasshopper then went missing from non-indigenous view.

Calaby and Key (1973) reported the dramatic rediscovery of Leichhardt's grasshopper in 1971 on a western outlier of the Arnhem Land plateau (now within Kakadu National Park). There quickly followed a flurry of specimens from other locations in the NT: along the western edge of the Arnhem Land plateau, near Maningrida on the north coast of Arnhem Land and at Katherine Gorge (now known as Nitmiluk) National Park. Subsequent collections have been made from Keep River National Park near the NT border with Western Australia and a number of other locations in western Arnhem Land and Kakadu National Park (Lowe 1995). There have also been anecdotal reports of the grasshoppers at other locations between Kakadu in the east and Keep River in the west. The brightly coloured adults are so singular in appearance that most such reports must be taken seriously. There is simply no other creature for which they could be easily mistaken.

Petasida ephippigera appears to feed almost exclusively on various species of shrubs within the genus *Pityrodia* (Verbenaceae). Collections on *Goodenia*, *Dampiera* (both Goodeniaceae) and *Gardenia* (Rubiaceae) (Calaby and Key 1973, Key 1984) seem to have been made in typical *Pityrodia* habitat and may have consisted largely of transient individuals or rarely utilised host plants.

While a number of populations of Leichhardt's grasshopper have now been documented in western Arnhem Land and Kakadu, the same is not true of Nitmiluk and Keep River National Parks, where only one and two populations respectively had been pinpointed prior to the surveys reported here. These populations were tiny and geographically isolated.

This paper documents the search for populations of *P. ephippigera* that had been previously reported in Nitmiluk and Keep River National Parks and reports the discovery of new populations and host plants.

Methods

A wide-ranging survey in rugged sandstone habitat was conducted in and around Keep River National Park, while targeted surveys were carried out in Nitmiluk National Park and southeastern Arnhem Land following reported sightings of Leichhardt's grasshoppers at specific locations. During surveys, all *Pityrodia* spp. seen were searched for nymphs of *P. ephippigera*. The precise location of each site where grasshoppers were found was determined using a GPS unit, the number of nymphs was recorded, the identity and number of *Pityrodia* spp. within a 3 m radius were recorded and notes were made on the physical characteristics of the site. Host plant voucher specimens were collected and lodged in the Northern Territory Herbarium.

Results

Keep River National Park

Helicopter flights were made on 9-10 December 2000, landing at 14 locations: where *Pityrodia ternifolia* had been previously collected; where Leichhardt's grasshoppers were known to occur; or in what appeared to be suitable terrain. On 11 December 2000, one known *P. ephippigera* site and three other likely areas were accessed by car.

One of the two locations previously recorded for *P. ephippigera* was near the base of large horizontally-bedded sandstone 'beehive' formations in an area that had recently been extensively burnt by a wildfire. *Pityrodia ternifolia* plants were found on two unburnt, elevated scree slopes and were re-sprouting from the base on one burnt sand pocket on a low sandstone platform, but no grasshoppers were found. An adjacent fenced site designated as sacred to the local indigenous owners of the land appeared not to have been completely burnt, but was not entered as the necessary permission had not been obtained.

The other known *P. ephippigera* site was below the rim of a gorge in a remote area accessible only by helicopter. Several dozen *P. ternifolia* plants were scattered along a horizontally-bedded sandstone platform at the base of one low escarpment and above another. Six *P. ephippigera* adults, including a mating pair (Fig. 1), were found on the plants (see Table 1). Due to the ruggedness of the terrain and limited time, it was not possible to survey the gorge more thoroughly for further grasshoppers.

P. ephippigera was found at a new site on Bullo River Station approximately 1.5 km east of the boundary of the proposed Spirit Hills extension to Keep River National Park (Table 1). This area was also accessible only by helicopter. Several dozen *P. ternifolia* plants were sparsely scattered across a steep, east-facing, scree slope on the edge of a small plateau and around the head of a nearby gully, generally in protected pockets between large rocks (Fig. 4). Only a single adult was seen despite a 1 hour search by two people. Similar habitat extends for several kilometres westwards into the proposed Park extension and it is possible that a larger population of grasshoppers exists nearby.

Nitmiluk National Park

Upper Katherine River gorge. During a vegetation mapping exercise above the Katherine River gorge in Nitmiluk National Park on 8-10 February 2001, *P. ephippigera* adults were found on both *Pityrodia lanuginosa* Munir and *P. puberula* Munir at least 10 kms east of the one previously known population in the Park. A survey team was dropped by helicopter into the vicinity of the new sightings and remained from 7-10 September 2001. A total of 173 nymphs of *P. ephippigera* were recorded from 84 sites, all found on plants of *P. lanuginosa* (Fig. 2, Table 1).

Table 1. Re-surveyed and newly discovered locations of Leichhardt's grasshopper, *Petasida ephippigera*, in Australia's Northern Territory (* = new location; † = new host plant record).

Latitude	Longitude	Host plant	Notes
15°37'S	129°14'E	*Pityrodia ternifolia*	Keep River, proposed Spirit Hills extension: 6 adults, 9 Dec. 2000
*15°38'S	129°30'E	*Pityrodia ternifolia*	Bullo River Station, 1.5 km east of Spirit Hills boundary: 1 adult, 10 Dec. 2000
15°45'S	129°05'E	*Pityrodia ternifolia*	Keep River: most of site had been recently burnt and no grasshoppers were seen, 11 Dec. 2000
14°18'S	132°25'E	*Pityrodia pungens*	Nitmiluk, near Visitor Information Centre, Sept. 2002
*14°14'S	132°26'E	unknown	Nitmiluk, ~9 km north of Visitor Information Centre: 1 adult, Jan. 1988; 1 nymph, 16 July 2002
*14°18'S	132°32'E	†*Pityrodia puberula*, †*P. lanuginosa*	Nitmiluk, above Katherine Gorge: 173 nymphs at 84 sites within 2.5 km radius, 7-10 Sept. 2001
*14°13'S	132°11'E	†*Pityrodia spenceri*	Nitmiluk, near Edith Falls: 18 nymphs at 13 sites within 2 km south along ridge, 15 Aug. 2002
*14°16'S	134°55'E	*Pityrodia ternifolia*	Southeastern Arnhem Land, ~80 km north of Ngukurr: 13 nymphs on 2 plants at 1 site, 24 Sept. 2002

Pityrodia lanuginosa plants were so sparsely distributed over the search area that nearly all sites consisted of a single plant. Three sites had two plants and two sites had three plants. More than half of the sites where *P. ephippigera* was found had only a single nymph and a maximum of nine nymphs were found at a single site (Fig. 6).

The plants on which *P. ephippigera* nymphs were found were frequently stunted, desiccated and shedding leaves and occasionally appeared to be dead. Robust, leafy plants greater than 1 m in height never carried nymphs. Nymphs were generally found on steep, boulder-strewn slopes or narrow ledges or gullies in cliff lines (Fig. 5). They only occasionally occurred on elevated, horizontally-bedded sandstone pavements or low, rocky knolls in broad, sandy valleys between sandstone ridges, although *P. lanuginosa* was often found in such places.

Edith Falls. During another vegetation mapping exercise on 1-3 May 2002, eight nymphs of *P. ephippigera* were found near Edith Falls in Nitmiluk National Park, approximately 30 km north of the other known occurrences of *P. ephippigera* in the region. They were all on plants of *Pityrodia spenceri* Munir. A survey team visited the area on 15-17 August 2002 and located 18

nymphs at 13 separate sites, all but one of which were on *P. spenceri* (Fig. 3). The exception was found on a senescent *P. lanuginosa* plant (Table 1). Two of the sites that contained *P. ephippigera* nymphs had plants of both *Pityrodia* spp. present, but the nymphs were found only on *P. spenceri*.

A wildfire swept through the area a few days after completing this survey. A follow-up survey conducted several weeks later, using GPS data to pinpoint the original grasshopper sites, relocated only three of the original 18 nymphs.

Other observations. The senior author photographed a single adult *P. ephippigera* in January 1988, approximately 9 km north of the Visitor Information Centre along the Katherine Gorge to Edith Falls walking track. It was first seen on the wing and could not be directly associated with any food plant. A nymph was seen in the same vicinity on 16 July 2002 (Q. Paynter, pers. comm.; Table 1) but the host plant was not identified.

Southeastern Arnhem Land

Following reports of brightly coloured grasshoppers made by local indigenous people, an area of outcropping sandstone approximately 80 km north of the town of Ngukurr in southeastern Arnhem Land was surveyed on 24 September 2002. Several hundred plants of *P. ternifolia* were searched in an area of extremely steep and rugged, horizontally-bedded 'lost city' sandstone outcrops. One plant supported nine nymphs while another nearby had four nymphs (Table 1).

Discussion

Food plants

It now seems likely that *P. ephippigera* feeds predominantly, or even exclusively, on plants within the endemic Australian genus *Pityrodia*. These perennial shrubs are found across a relatively broad geographic range in the NT (Dunlop and Bowman 1986, Lowe 1995), but the distribution of suitable habitat within that range is extremely patchy. The plants grow on rocky sandstone outcrops, coarse scree slopes at the base of sandstone escarpments, fissured pavements at the top of sandstone plateaux and in sand pockets and drainage lines associated with exposed sandstone in the Top End of the NT (Figs 4-5).

Petasida ephippigera has been known to feed on three different species of *Pityrodia*: *P. jamesii* Specht in western Arnhem Land and Kakadu National Park (Calaby and Key 1973, Lowe 1995), *P. pungens* Munir in Nitmiluk National Park (ABC 2000), and *P. ternifolia* (F. Muell.) Munir in Keep River National Park (Lowe 1995). The surveys reported here increase the known host range to include *P. lanuginosa* Munir above the Katherine River gorge and *P. spenceri* Munir near Edith Falls, both places within Nitmiluk National Park. We also record adults for the first time on *P. puberula* Munir, but whether or not this plant supports nymphal development remains to be determined.

At any one location *P. ephippigera* has generally been found feeding on only a single species of *Pityrodia*. These different associations may largely reflect the relative availability of *Pityrodia* species at each place rather than any site-specific shift in feeding preferences, although near Edith Falls *P. lanuginosa* and *P. spenceri* were sympatric but, with one exception, only the latter hosted *P. ephippigera* nymphs.

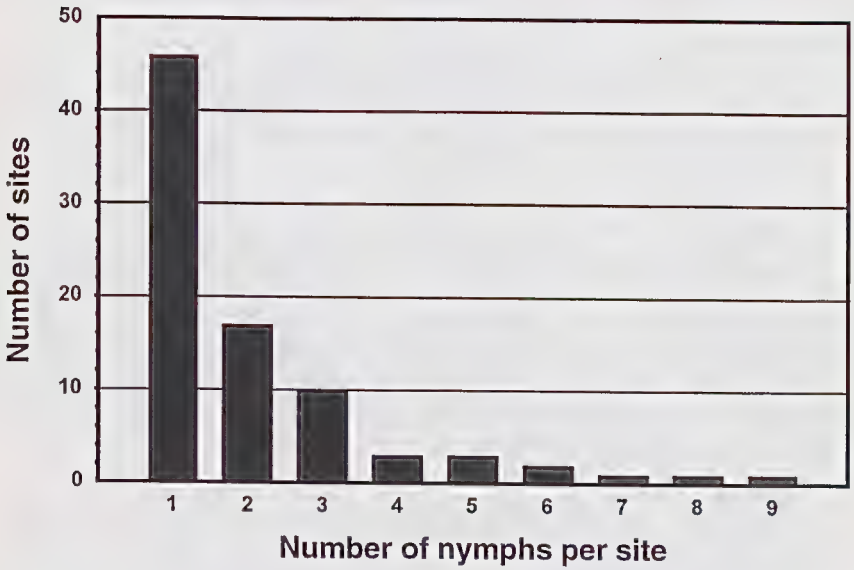

Fig. 6. The number of *Petasida ephippigera* nymphs per site where they occurred, above the Katherine River gorge in Nitmiluk National Park, 7-10 September 2001.

Distribution and abundance

Petasida ephippigera occurs within national parks that attract large numbers of visitors throughout the year but it is still seldom seen. As it is such a large, eye-catching grasshopper and we now have good information on host plants and habitat, the dearth of sightings has led to the conclusion that it must be extremely rare. However, the results of the surveys reported here suggest that perhaps the perceived status of *P. ephippigera* should be reviewed.

The *Pityrodia* species surveyed in this study are small, sparse shrubs, frequently masked by large, prickly clumps of spinifex grass (*Triodia* spp.) or growing in crevices between boulders and distributed only sporadically in the landscape. The difficult terrain in which they grow is usually remote from roads and human habitation and the steep rocky sites favoured by the plants are not often trodden, even by the few hardy souls who sometimes traverse the sandstone country on foot.

The vivid *P. ephippigera* adults (Fig. 1) are found only during the tropical summer wet season when temperature and humidity are high and widespread flooding makes human travel to remote areas difficult and dangerous. The nymphs, which are found during the cooler winter dry season, have relatively cryptic colouration and are very small during the months most favourable to human comfort, beginning their growth spurt as temperature and humidity rise in the build-up to the wet season. Where populations of *P. ephippigera* occur, only a small proportion of *Pityrodia* plants carry grasshoppers and even then most have only a single individual (Fig. 6).

The inescapable conclusion is that most *P. ephippigera* populations remain hidden from casual observation. Nymphs are relatively inconspicuous and adults only occur at a time of year when few people are in the field, in places rarely visited at any time of year.

The new findings in Nitmiluk National Park to the south of Kakadu point to the possibility of widespread, if sparse, populations of *P. ephippigera* occurring in the vast area of inaccessible, rugged, exposed sandstone country around the shared boundary of the two parks. The discoveries north of Ngukurr, 300 km to the east of Kakadu and Nitmiluk, and on Bullo River Station, 300 km to the west, suggest other populations in extensive areas of suitable habitat throughout the Top End (Fig. 7) and possibly into the Kimberley region of northern Western Australia. Further surveys are now required to test these predictions.

Susceptibility to fire

Petasida ephippigera has been listed as vulnerable under the Territory Parks and Wildlife Conservation Act 2000, mainly due to concerns about the vulnerability of both the grasshopper and its host plants to the altered fire regimes occurring within the sandstone heath communities, as the human populations in these regions have declined over the last century (Russell-Smith *et al.* 1997, 1998). The passage of fire has already been implicated in local extinctions of *P. ephippigera* in Kakadu National Park (Lowe 1995), in the apparent disappearance of one of the two populations previously recorded from Keep River National Park and in the decline of the newly discovered population near Edith Falls.

The sandstone heathlands inhabited by *Pityrodia* spp. and *P. ephippigera* are rarely targeted for deliberate burning, but uncontrolled wildfires still enter this habitat on occasions, usually during the latter months of the dry season when temperatures, wind speeds and fuel loads are high and moisture levels low. These late season fires tend to be larger in extent, hotter and less patchy than earlier fires. The flightless nymphs of *P. ephippigera* that are present at this time have little chance of escaping fire. Even if some can find refuge beneath rocks, their diet specialisation reduces their chance of finding acceptable food in the aftermath.

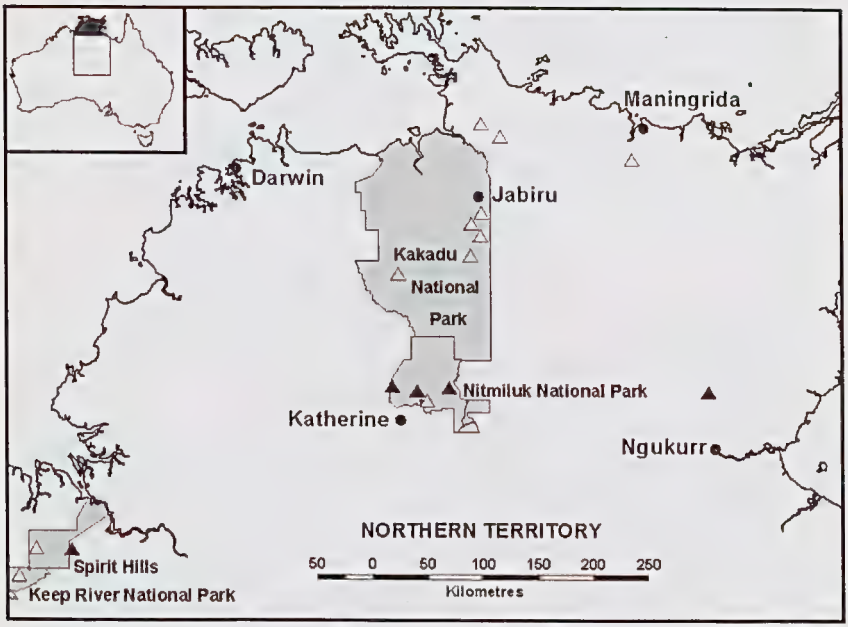

Fig. 7. Known localities of *Petasida ephippigera* in Australia: Δ = previous records; ▲ = new records. National Parks containing known populations of *P. ephippigera* are shaded grey.

Areas from which *P. ephippigera* have been lost in Kakadu require several years for recolonisation. As a result it has been suggested that adults have poor dispersal abilities (Lowe 1995). However, the sporadic distribution of both the grasshoppers and their host plants in Nitmiluk National Park, as well as the preponderance of solitary nymphs (Fig. 6), could suggest a more mobile adult population to enable mating and widely scattered oviposition. If this is so, occasional fires within the core habitat of *P. ephippigera* would pose no significant threat to its continued survival. Should the populations in southeastern Arnhem Land and Keep River/Bullo River prove to be small and isolated, however, wildfires could lead to their extirpation with no chance of recolonisation.

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